

STUDIES IN MACQUARIE ISLAND LICHENS 4: THE GENERA CLADIA AND CLADONIA

by

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ABSTRACT

Filson, R. B. & Archer, A. W. Studies in Macquarie Island lichens 4: The genera *Cladia* and *Cladonia*. *Muelleria* 6(3): 217-235 (1986). — The species of *Cladia* and *Cladonia* which occur on Macquarie Island are examined critically and a full description of each is provided. Previous records are discussed and synonymy is given. The chemistry of each species was examined and the results are presented together with a taxonomic key and distribution maps. *Cladonia subantarctica* Filson & Archer is described as new.

INTRODUCTION

This paper is a continuation of a series of papers on the lichens of Macquarie Island (Filson 1981, 1981a, 1986). *Cladonia* is a very common and easily collected fruticose genus and almost every biologist who collected lichens on Macquarie Island has brought back representatives of it (see Filson 1981). The first definitive treatment of the Macquarie Island Cladoniae was by Dodge (1948), who enumerated four species, including two species and one variety new to science. Six species were enumerated for the Horning collection (Lowry et. al. 1978), two of which, *C. aueri* Räsänen and *C. foliaceae* (Huds.) Willd. are not included in this paper as unfortunately relevant specimens have not been located. Although not available for examination, the specimen of *C. aueri* probably is referable to *C. subsubulata* Nyl., and the record of *C. foliaceae* is apparently due to misidentification as this taxon is endemic to the coastal regions of Europe. This paper is based on the collections cited in Filson (1981) as more recent collections have not been made available for study.

The lichen compounds present in the specimens cited were identified by thin-layer chromatography; acetone extracts of specimens were examined using the solvent systems of Culberson (Culberson 1972) and the separated compounds were detected with sulphuric acid (Culberson 1972) and MBTH (Archer 1978).

TAXONOMY

KEY TO SPECIES OF CLADIA AND CLADONIA

1. Thallus lacking a primary thallus; supportive tissue on the outside as a cartilaginous cortex; cortex perforate with sub-round fenestrations *Cladia aggregata*
1. Thallus mostly with a basal primary thallus; supportive tissue a cartilaginous layer on the inside of the podetia; cortex not perforate, without sub-round fenestrations *Cladonia*
2. Thallus consisting of primary squamules only, stictic acid present *Cladonia wilsonii*
2. Thallus consisting of well-developed podetia as well as basal squamules
3. Apothecia and pycnidia red
4. Cups abruptly flaring towards the top, K+ yellow (thamnolic acid) *Cladonia subdigitata*
4. Cups gradually tapering from the base, K- (Usnic and isousnic acid) *Cladonia pleurota*
3. Apothecia and pycnidia brown
5. Podetia wholly corticate
6. Podetia forming cups
7. Cups proliferating from the centre, with or without squamules *Cladonia cervicornis* ssp. *verticillata*
7. Cups proliferating from the margins or not proliferating

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- 8. Interior of the cups perforated
 - 9. Cortex strongly rugulose, nitid, epruinose, P+ red (fumarprotocetraric acid) *Cladonia furcata*
 - 9. Cortex smooth or only weakly rugulose, dull, pruinose, P- (barbatic acid) *Cladonia subantarctica*
- 8. Interior of the cups imperforate
 - 10. Podetia nitid, epruinose, K-, atranorin absent *Cladonia gracilis*
 - 10. Podetia dull, squamulose, pruinose in the upper parts, K+ yellow, atranorin present *Cladonia ecmocyna*
- 6. Podetia subulate or distorted, not forming cups
 - 11. Podetia simple, once or twice divided or sparsely branched
 - 12. Podetia with few scattered squamules
 - 13. Axils open
 - 14. Cortex strongly rugulose, nitid, epruinose, P+ red (fumarprotocetraric acid) *Cladonia furcata*
 - 14. Cortex smooth, only weakly rugulose, dull, pruinose, P- (barbatic acid) *Cladonia subantarctica*
 - 13. Axils closed *Cladonia gracilis*
 - 12. Podetia thickly squamulose *Cladonia ecmocyna*
 - 11. Podetia split, branched at the apices many times *Cladonia wilsonii*
- 5. Podetia ecorticate or only partly corticate in the lower parts
 - 15. Podetia sorediate
 - 16. Podetia forming well-developed cups
 - 17. Podetia granular-sorediate *Cladonia chlorophaea*
 - 17. Podetia covered in small, flat, peltate squamules *Cladonia pyxidata*
 - 16. Podetia subulate, not forming well-developed cups
 - 18. Lower part of the podetium corticate, upper part covered in farinose soredia
 - 19. Podetia short, thick; podetial squamules in the lower part; soredia abundant *Cladonia cornuta*
 - 19. Podetia tall, slender; podetial squamules may reach the tip; soredia sparse *Cladonia scabriuscula*
 - 18. Lower part of the podetium not corticate
 - 20. Soredia farinose, disintegrating in the upper parts, exposing the thin medulla and inner cartilaginous layer *Cladonia corniculata*
 - 20. Soredia granular, persistent to the apex, rarely disintegrating in small patches *Cladonia coniocraea*
 - 15. Podetia esorediate
 - 21. Podetia squamulose, inner cartilagenous layer not exposed
 - 22. Podetia forming cups *Cladonia pyxidata*
 - 22. Podetia subulate, apically branched *Cladonia scabriuscula*
 - 21. Podetia esquamulose; medulla thin, exposing the inner cartilagenous layer *Cladonia corniculata*

CLADIA

Cladia aggregata (Sw.) Nyl., *Recogn. Ram.* 69 (1870). — *Lichen aggregatus* Sw., *Nov. Gen. Pl.* 147 (1788). TYPE: "Jamaica, O.P. Swartz." (S! LECTOTYPE).

Thallus fruticose, composed of pseudopodetia, variable in size, from as low as a few mm in exposed positions and to 80 mm tall in sheltered habitats, hollow, horny, rigid and fragile when dry, dichotomously or irregularly branched, flexuose, prostrate or ascending; colour varied, cream, straw, brown to almost black; walls perforate; perforations round to elliptic; cortex smooth, dull to nitid. *Fertile pseudopodetia* only slightly taller than the sterile pseudopodetia, more intricately branched and perforate towards the tips. *Apothecia* terminal on short branchlets, sessile, to 0.8 mm diam.; disk slightly concave to flat, matt, brownish-black to black; hymenium to 50 μm tall, brown; paraphyses simple, 1.5 μm diam., apical cell expanded to 4 μm ; asci 48 x 11 μm ; ascospores 12-15 x 4-5 μm , simple, hyaline. *Pycnidia* on tips of sterile pseudopodetia, ellipsoidal, black; microconidia 5 x 1 μm , curved.

REACTIONS: K-, C-, KC-, P-.

CHEMISTRY: Barbatic acid, fumarprotocetraric acid, ursolic acid, protocetraric acid, and a trace of 4-O-demethylbarbatic acid.

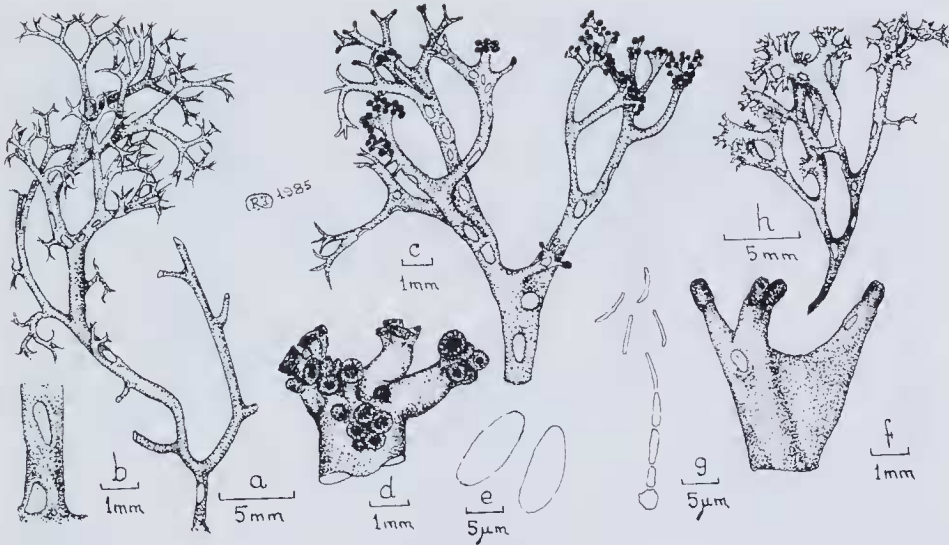


Fig. 1. *Cladia aggregata*. a — single pseudopodium separated from a clump; b — enlargement of portion of pseudopodium showing fenestrations; c — upper part of fertile pseudopodium showing apothecia and pycnidia; d — enlargement of apothecia; e — ascospores; f — enlargement of pycnidia; g — microconidia-bearing hyphae and microconidia; h — inflated and distorted pseudopodium separated from a moss cushion. a-g, from MEL 20274; h, from MEL 1032792.

SELECTED SPECIMENS EXAMINED:

Handspike Point on rocky outcrop c. halfway between base of Point and bottom of escarpment, 11.iii.1964, R. Filson 6321 & P. Atkinson (MEL 20298); lower slope of Boot Hill, 10.i.1972, R. Hnatiuk (MEL 1032813); W. slope of Mt Elder 200 ft below summit in slight col above and SW. of Upper Nuggets penguin colonies, 2.viii.1965, K. Simpson B11 (MEL 30317); on *Azorella* cushions c. half way along W. shore of Gratitude Lake, 4.ii.1964, R. Filson 5948 & J. Phillips (MEL 20293); top of scree slope above Hurd Point, 13.ii.1964; R. Filson 6125 & P. Atkinson (MEL 40203).

DISCUSSION:

Cladia aggregata grows amongst mosses and grasses, sometimes deep in the cushions of *Azorella selago* with only the tips of the ultimate branchlets protruding above the surface. It may be confused with *Sphaerophorus tener* (Laurer) Zahlbr., which occupies the same habitat. *C. aggregata* can be distinguished by the darker colour and hollow thallus with round to elliptical perforations through the cortex into the central canal.

Only one fertile specimen from the study area has been seen. It was growing in a sheltered position between rocks on the hillside on the south-eastern side of Lake Prion (MEL 20274).

CLADONIA

Cladonia cervicornis ssp. *verticillata* (Hoffm.) Ahti, Lichenologist 12: 126 (1980). — *Cladonia pyxidata* * *C. verticillata* Hoffm., Deutschl. Fl. 2: 122 (1796). — *Cladonia verticillata* (Hoffm.) Schaerer, Lich. Helvet. Spic. 31 (1823). TYPE: not known (Ahti 1980: 126).

Cladonia mawsoni Dodge, B.A.N.Z. Antarctic Res. Exped. 1929-31, Rep. Ser., B. Zool.-Bot. 7: 128 (1948). TYPE: "Macquarie Island, north end, Sta. 81. B.A.N.Z.A.R.E. B543-4." (Herb. Dodge, n.v.).

Thallus fruticose, growing amongst mosses or in sheltered positions on hillsides; primary squamules mostly persistent but sometimes disappearing, varying in size

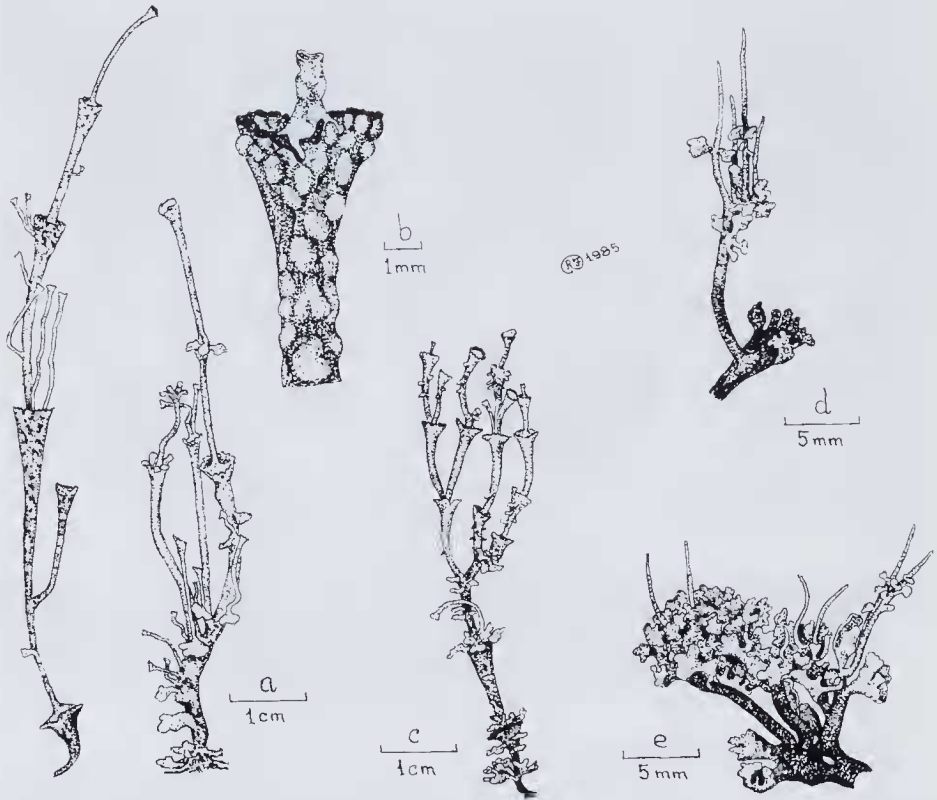


Fig. 2. *Cladonia cervicornis* ssp. *verticillata*. a — two old weathered podetia showing habit; b — enlargement of scyphus showing the central proliferation; c — podetia showing habit of a much-branched and proliferating thallus; d-e — small subulate thalli. All portions below the squamules were buried in a moss cushion. a-b, from MEL 7712; c, from MEL 20279; d-e, from MEL 30358.

and number, to 5.0(–8.0) mm long and 4.0 mm wide, crenulate to irregularly-lobed, sometimes deeply incised, flat or convolute; upper side corticate, olive-green to brownish-green; lower side ecorticate, white, sometimes blackening towards the base. *Podetia* to 80 mm tall with regular, broad, closed cups which proliferate from the centre, sometimes with several tiers of cups; margin of cups entire or with apothecia or pycnidia; cortex continuous or areolate, dull, dark olive-green to brown, sometimes blackening between the areolae, esorediate, with or without squamules. *Apothecia* brown, sessile on the margins of the cups. *Pycnidia* not seen.

REACTIONS: K–, C–, KC–, P+ red.

CHEMISTRY: Fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Camp Hill, 19.iii.1966, K. Simpson E96, (MEL 30358); vicinity of the Nuggets Valley, 7.ix.1948, N. Laird (MEL 7712); 1 mile N. of Bauer Bay, 28.i.1964, R. Filson 5834 (MEL 20279); N. side of Aurora Point, 11.ii.1964, R. Filson 6296 & K. Simpson (MEL 20283).

DISCUSSION:

This subspecies is very distinctive, as it is the only taxon in the study area which proliferates from the centre of the cups. *Cladonia cervicornis* ssp. *verticillata*

is readily determined by the continuous cortex and the even margin of the closed cups. There are two distinct forms on the island, one with few podetial squamules, the other with densely squamulose podetia. The densely squamulose form may be referable to *Cladonia cervicornis* f. *phyllocephala* (Flotow) Oliver.

Cladonia chlorophaea (Flörke ex Somm.) Sprengel, in Linn., Syst. Veg. ed. 16, 4: 273 (1827). — *Cenomyce chlorophaea* Flörke ex Somm., Suppl. Fl. Lapon. 130 (1826). TYPE: not known (Ahti 1966: 382).

Cladonia floriformis Dodge, B.A.N.Z. Antarctic Res. Exped. 1929-31, Rep. Ser., B. Zool.-Bot. 7: 134 (1948). TYPE: "Macquarie Island, north end, Sta. 81. B.A.N.Z.A.R.E. 540-9." (Herb. Dodge, n.v.)

Thallus fruticose, growing over moss cushions, peat or litter; primary squamules persistent, to 5 mm long, deeply incised to lacerate, with crenate margins; upper side smooth, convex, brownish-green to pale greenish-olive, esorediate; lower side white, sometimes darkening towards the base. *Podetia* arising from the primary squamules, cup-forming, but occasionally subulate, the cups flaring gradually, regular to irregular, proliferating from the margins, the base of the podetium corticate; cortex areolate; upper parts of the podetium becoming decorticate and granular-sorediate. *Apothecia* brown, sessile on small denticulate proliferations on the margins of the cups, or sessile on the margins of the cups, to 0.25(-0.3) mm diam.; margin slightly raised. *Pycnidia* brown, on denticulate proliferations on the margins of the cups or terminal on subulate podetia, sessile to stipitate.

REACTIONS: K -, C -, KC -, P + red.

CHEMISTRY: Fumarprotocetraric acid.

SPECIMENS EXAMINED:

Vicinity of Nuggets Creek, 20.viii.1948, *N. Laird* (MEL 7738); Langdon Point on N. side of ridge between Hill 330 and the plateau, 14.ii.1964, *R. Filson 6301* & *K. Simpson* (MEL 20298); Brothers South Ridge, W. of Brothers Summit, 14.viii.1965, *K. Simpson A85* (MEL 30338); c. 1.5 miles S. of Green Gorge, 21.i.1964, *R. Filson 5753* & *N. Barrett* (MEL 20252); Caroline Cove, N. of Caroline Creek, 20.i.1966, *K. Simpson E69* (MEL 30351).

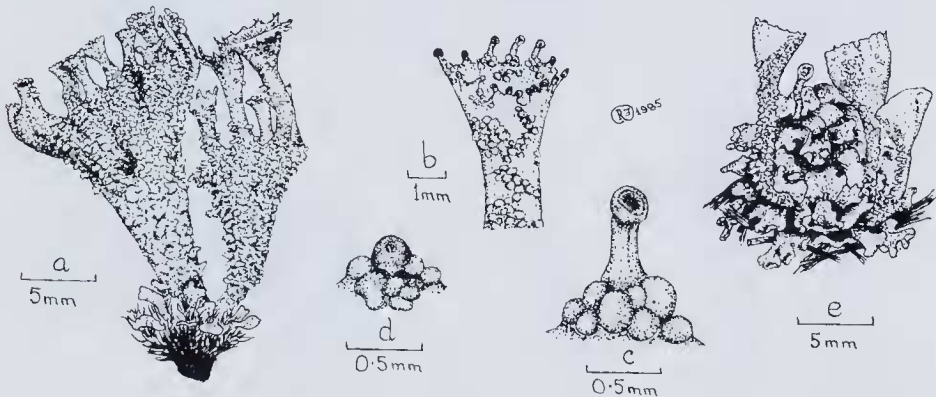


Fig. 3. *Cladonia chlorophaea*. a — two squamulose podetia showing marginal proliferations; b — enlargement of scyphus showing pycnidia and marginal teeth with apothecia; c — enlargement of marginal tooth with apothecia; d — enlargement of pycnidia on the margin of scyphus; e — habit showing three podetia arising from primary squamules growing over litter. a-d, from MEL 20252; e, from MEL 7738.

DISCUSSION:

Cladonia chlorophaea is a widely distributed lichen species with a very variable chemistry. This has resulted in several taxa being segregated by virtue of chemistry alone. The populations on Macquarie Island, however, are all placed in *C. chlorophaea* sens. strict., as they contain only fumarprotocetraric acid. This species may be confused with *C. pyxidata*, but it is distinguished by the sorediate upper part of the podetium in contrast to the squamulose upper part in *C. pyxidata*. It is also similar to *C. pleurota*, but it differs in having a grey-green colour rather than the yellow-green (usnic and isousnic acids) colour of *C. pleurota*. The type material of *C. floriformis* has not been examined. However, the material held at MEL, determined as *C. floriformis* by Dodge and cited in Dodge & Rudolph (1955) is referable to *C. chlorophaea*.

Cladonia coniocraea auct. sensu Ahti 1980, p. 130, non Flörke, Deutsche Lich. 7: 14 (1821).

[*Cladonia sarmentosa* (Taylor) Dodge, sensu Dodge 1948, p. 129, non *Cenomyce sarmentosa* Taylor.]

Thallus fruticose, growing over mosses, decaying grasses, litter and peat; primary squamules persistent, large, almost as broad as long, to 7.0 mm diam.; margins flexuose, smooth when young, becoming lobed and incised with age; upper side smooth, pale grey-green to creamy-brown; lower side white, granular-sorediate. *Podetia* arising from the upper side of the primary squamules, very variable, subulate or with small cups, to 25 mm tall and to 2.0(-4.0) mm thick, sometimes branched and often divided near the apex, corticate only at the very base of the podetium, subcontinuous and areolate, sometimes squamulose; upper parts decorticate and sorediate; soredia farinose. *Apothecia* brown, on the tips of the podetia. *Pycnidia* brown, on the tips of the podetia.

REACTIONS: K- or K+ faint brown, C-, KC-, P+ red.

CHEMISTRY: Fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Vicinity of Nuggets Creek, 20.viii.1948, *N. R. Laird* 1c (MEL 7732); c. 1 mile N. Bauer Bay near Boiler Rocks, 28.i.1964, *R. Filson* 5815 (MEL 1024215); N. side of Aurora Point, 11.ii.1964, *R. Filson* 6299 & *K. Simpson* (MEL 20255); N. Lusitania Bay, 200 ft, 29.xii.1971, *R. Hnatiuk* (MEL 1032800); Bank of creek flowing into E. side of Caroline Cove, 11.x.1965, *K. Simpson* A60 (MEL 30336).

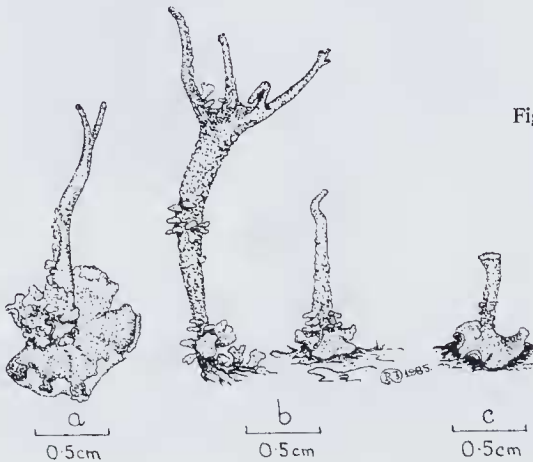


Fig. 4. *Cladonia coniocraea*. a — Podetium with divided tip arising from a large primary squamule; b — two podetia showing simple and branched forms; c — podetium with small cup. a, from MEL 20255; c, from MEL 7732.

DISCUSSION:

Ahti (1980) discusses the nomenclature of the *C. coniocraea*-*C. ochrochlora* group. He points out that whilst he considers that there are two species involved (Ahti 1977), the types of the two names are conspecific. The problem needs further investigation and in the interim he recommends using the name *C. coniocraea* auct. for the species which has subulate podetia or very small cups and is only slightly corticate at the base.

On Macquarie Island this taxon may be confused with *C. cornuta* and *C. corniculata*. It can be separated from *C. cornuta* by being partly corticate at the base of the podetia, in having fewer podetial squamules and in that the podetia are often divided towards the apex. *C. corniculata* differs from *C. coniocraea* by being completely ecorticate, by having a very thin medulla which exposes the inner cartilagenous sheath and by the lack of large persistent basal squamules.

Cladonia corniculata Ahti & Kashwadani in Inoue, Studies on Cryptogams in Southern Chile 136 (1984). TYPE: "Chile. Prov. Llanquihue: Around top of Cerro Pavilo, ca 16 km west of Tegalalda, alt. 800-870 m, in wet *Fitzroya* forest, in 1981 H. Kashwadani 17882." (TNS n.v. HOLOTYPE; H! ISOTYPE).

Thallus fruticose, growing out through the tops of moss cushions; primary squamules mostly disappearing though sometimes persistent, to 2.5 mm long and 2.0 mm wide, lobed, flexuose; upper side smooth, cream to pale yellow-green; lower side white to very pale grey, grading to creamy-yellow towards the base. *Podetia* to 40 mm tall, mostly branched towards the apices; tips subulate; surface entirely sorediate; soredia disintegrating to expose the thin white medulla or the internal cartilagenous layer which is lightly ridged or grooved. *Apothecia* not seen. *Pycnidia* brown, globose, in cylindrical projections terminal on the branches; microconidia not seen.

REACTIONS: K -, C -, KC -, P + red.

CHEMISTRY: Fumarprotocetraric acid.

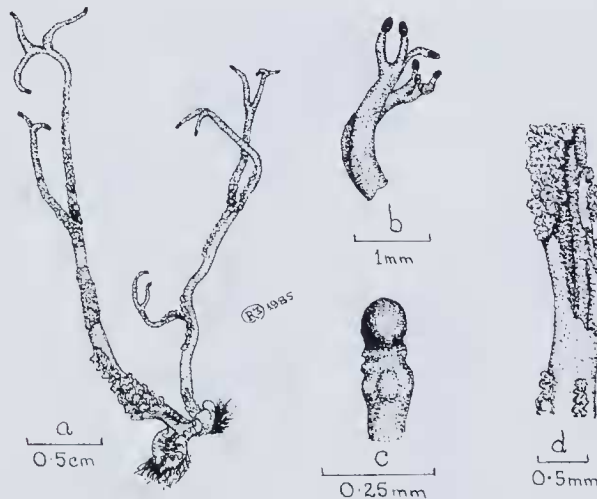


Fig. 5. *Cladonia corniculata*. a — podetia separated out from a clump showing habit; b — enlargement of ultimate branchlet showing pycnidia; c — enlargement of pycnidium; d — enlargement of portion of podetium showing soredia, medulla and exposed cartilagenous tissue. All from MEL 20267.

SPECIMEN EXAMINED:

Lusitania Creek, 10.ii.1964, R. Filson 5993 & P. Atkinson (MEL 20276).

DISCUSSION:

Cladonia corniculata was described initially from Chile. In their discussion, the authors of the name say that the species is similar to *C. subulata* (L.) Wigg, but is separated from that species in the complete absence of scyphi, and that the soredia are strongly caducous, whereas they are rather persistent in *C. subulata*.

Unbranched podetia may appear similar to those of *C. cornuta* but they can be distinguished by being completely ecorticate. *C. corniculata* may appear similar to *C. scabriuscula* but that species is squamulose and only sparsely sorediate.

Cladonia cornuta (L.) Hoffm., Plant. Lich. 1: plate 25 (1791). — *Lichen cornutus* L., Sp. Pl. 2: 1152 (1753). TYPE: "Habitat in Europae ericetis." (OXF n.v., not typified Ahti 1980a: 219).

Thallus growing amongst mosses; primary squamules persistent or disappearing, to 6.0 mm long and 2.5 mm wide, crenulate to irregularly-lobed; upper side corticate, green to pale olive-green; lower side white, ecorticate, esorediate. *Podetia* to 60 mm tall and 3.0 mm wide, cupless, cylindrical, subulate; lower parts of the podetium areolate-corticate, dull white to very pale brownish-yellow, often densely covered with squamules similar to the primary squamules; upper part of the podetium ecorticate, becoming sorediate, the ultimate tip covered with farinose soredia. *Apothecia* and *pycnidia* not seen.

REACTIONS: K —, C —, KC —, P + red.

CHEMISTRY: Fumarprotocetraric acid.

SPECIMEN EXAMINED:

Amongst mosses, c. one and a half miles S. of Green Gorge, 22.i.1964, R. Filson 5753a & N. Barrett (MEL 20275).

DISCUSSION:

This species is very widespread, being reported from Australia, New Zealand,

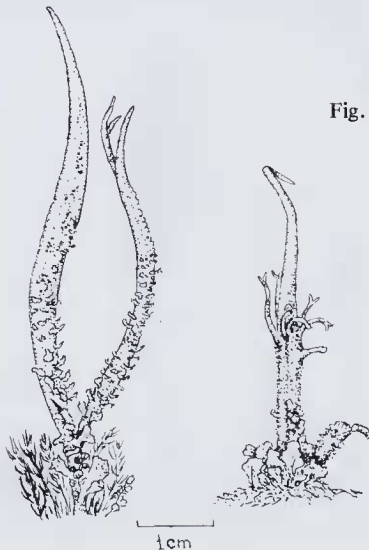


Fig. 6. *Cladonia cornuta*. Two podetia growing amongst mosses. From MEL 20275.

South America, Africa, Africa and the Kerguelen Islands as well as many localities in the Northern Hemisphere, but there is only one collection from Macquarie Island. At this site it was moderately abundant, growing on the hillside amongst mosses and grasses in an easterly aspect in the headwaters of Sawyers Creek.

Cladonia ecmocyna Leighton, Ann. Mag. Nat. Hist. ser. 3, 18: 406 (1866). TYPE: "USSR, Murmansk Region, Kola Peninsula, Svyatoy nos, N. I. Fellman, Lich. arct. 28, 1863." (BM! LECTOTYPE).

Thallus fruticose, mostly embedded in moss cushions or sometimes clumped in sheltered positions, the lower parts dying away, upper parts continuing to grow; primary squamules persistent or disappearing, to 5.0 mm long and 3.0 mm wide, crenulate to irregularly-lobed, flat to concave, grey-green to pale brown above, white, ecorticate below. *Podetia* simple or branched, to 60 mm tall and to 1.0 mm diam., with or without scyphi, most often subulate though often swollen and misshapen; scyphi narrow, with dentate margins, which sometimes grow into secondary scyphi or subulate secondary podetia; scyphi sometimes proliferating from one side to form a dorsiventral oar-shaped body; cortex areolate, dull, slightly pruinose, pale grey to greyish-brown, esorediate, often squamulose in the lower parts, infrequently with scattered squamules to the tip; areolae somewhat pulvinate. *Apothecia* not seen. *Pycnidia* common on tips of branches or margins of the scyphi, dark brown to black, constricted at the base; microconidia not seen.

REACTIONS: K+ yellow, C-, KC-, P+ red.

CHEMISTRY: Atranorin and fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Gadgets Gully, 18.iii.1964, R. Filson 6362 & R. Peterson (MEL 20410); on tundra N. of Mt Hamilton, alt. 800 ft. 29.xii.1971, R. Hnatiuk 11556 (MEL 1027188); abundant on the summit of Mt Hamilton, 13.ii.1964, R. Filson 6102 & P. Atkinson (MEL 20302).

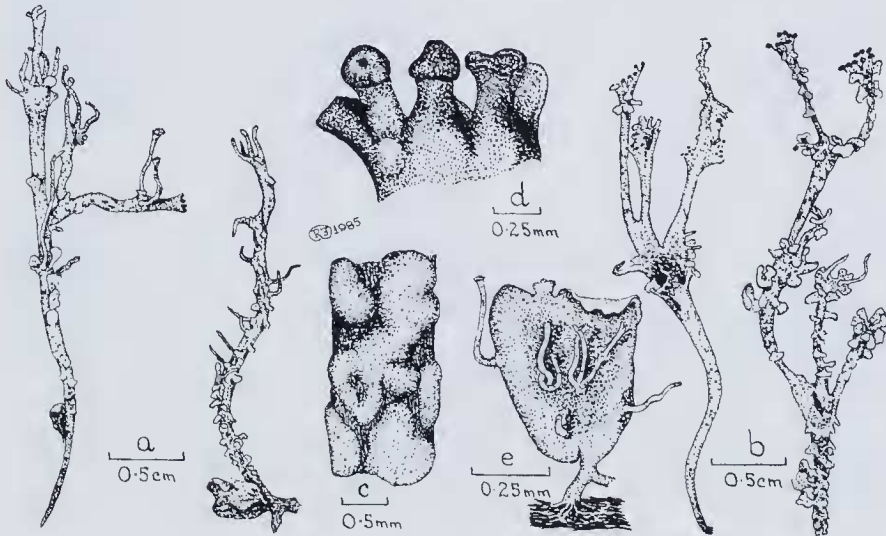


Fig. 7. *Cladonia ecmocyna*. a — two distorted podetia showing habit; b — two podetia showing distorted scyphi and squamulose thallus; c — enlargement of portion of podetium showing pulvinate cortex; d — enlargement of margin of scyphus showing pycnidia; e — primary squamule showing primordia of podetia. a-c, from MEL 20302; b, d-e, from MEL 20410.

DISCUSSION:

Cladonia emocyna forms part of the "gracilis group" and is often included as a subspecies of *C. gracilis*. However it differs from that species by the dull, often pruinose cortex and the presence of atranorin (K+ yellow reaction). It is common on Macquarie Island where it favours moist areas.

***Cladonia furcata* (Huds.) Schrad., Spic. fl. Germ. 107 (1794). — *Lichen furcata* Huds. Fl. angl. 458 (1762). TYPE: "n.69, in ericetis et locis montosis." (?BM n.v.).**

Thallus fruticose, ascending or subprostrate; primary squamules disappearing. *Podetia* cupless, terete to subterete, to 75(-90) mm tall and 0.1 mm diam., widening towards the joints, simple or branched; branching dichotomous or sometimes in whorls towards the tips and then sometimes almost forming cups; axils commonly widened and mostly open; ultimate branchlets subulate, occasionally in severe habitats becoming swollen and misshapen; cortex continuous, smooth in the lower parts, grading to verruculose to smoothly areolate above, dull to shining, esorediate, with or without podetial squamules, pale creamish-olive to warm cinnamon to dark brown where exposed but always pale where protected; squamules to 1 mm long, irregularly crenate, corticate and concolourous with the thallus above, ecorticate below. *Apothecia* not seen. *Pycnidia* at the tips of the ultimate branchlets, cylindrical to almost globose, 0.25 mm diam., dark brown to black, sometimes pruinose; microconidia 6-8 x 1.0 μ m, curved.

REACTIONS: K-, C-, KC-, P+ red.

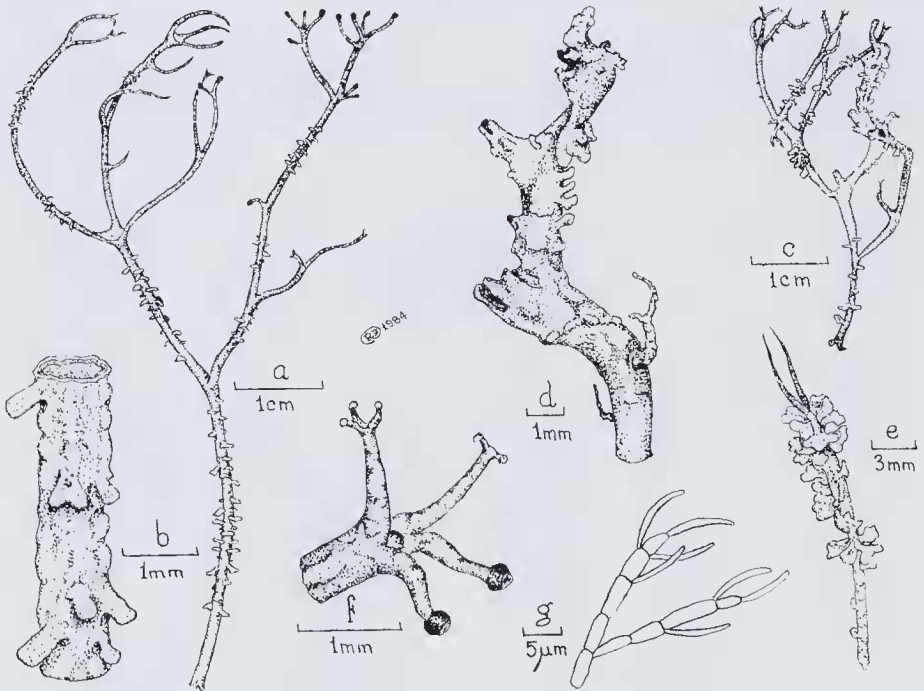


Fig. 8. *Cladonia furcata*. a — habit; b — enlargement of part of podetium; c — branched podetium with misshapen branch; d — enlargement of misshapen branch; e — small squamulose podetium; f — enlargement of tip of podetium showing pycnidia; g — microconidia-bearing hyphae. a-b, from MEL 1033025, c-d, f, g, from MEL 20280; e, from 30350.

CHEMISTRY: Fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Handspike Point, 17.i.1972, *R. Hnatiuk* (MEL 1033025); growing on featherbed c. 1 mile N. of Bauer Bay, 28.i.1964, *R. Filson 5811* (MEL 20280); N. Lusitania Bay, 900ft, 29.xii.1971, *R. Hnatiuk* (MEL 1032795); Display Hill, 20.i.1966, *K. Simpson E86* (MEL 30350); Mt Haswell, 12.ii.1964, *R. Filson 6017* & *P. Atkinson* (MEL 20263).

DISCUSSION:

This species and the following taxon, *C. gracilis* ssp. *tenerrima*, are very similar. They grow in the same habitat, deep in moss cushions with only the upper parts protruding. These exposed parts become twisted and contorted by the harsh weather conditions. There are small specimens in herbaria that are impossible to separate, but if sufficient material is available they can be distinguished by the open cups and axils of *C. furcata* in contrast to the closed cups and axils of *C. gracilis* ssp. *tenerrima*.

Cladonia gracilis ssp. *tenerrima* Ahti, Ann. Bot. Fennici 17: 208 (1980). TYPE: Australia. Victoria. Cathedral Range, North Jawbone, 5 km NW. of Buxton, on flat area amongst grasses just west of the summit, 1979, *Rex Filson 16627* (MEL 1023710! HOLOTYPE: BM!, H! ISOTYPES).

Thallus fruticose, growing amongst mosses, hepatics and other lichens; primary thallus persistent or disappearing. *Podetia* very variable, to 1.0 mm diam. and to 50 mm tall, with or without scyphi, simple or branched; inner membrane of the cups and axils closed, cups shallow and flaring rapidly, to 2.5 mm diam., prolif-

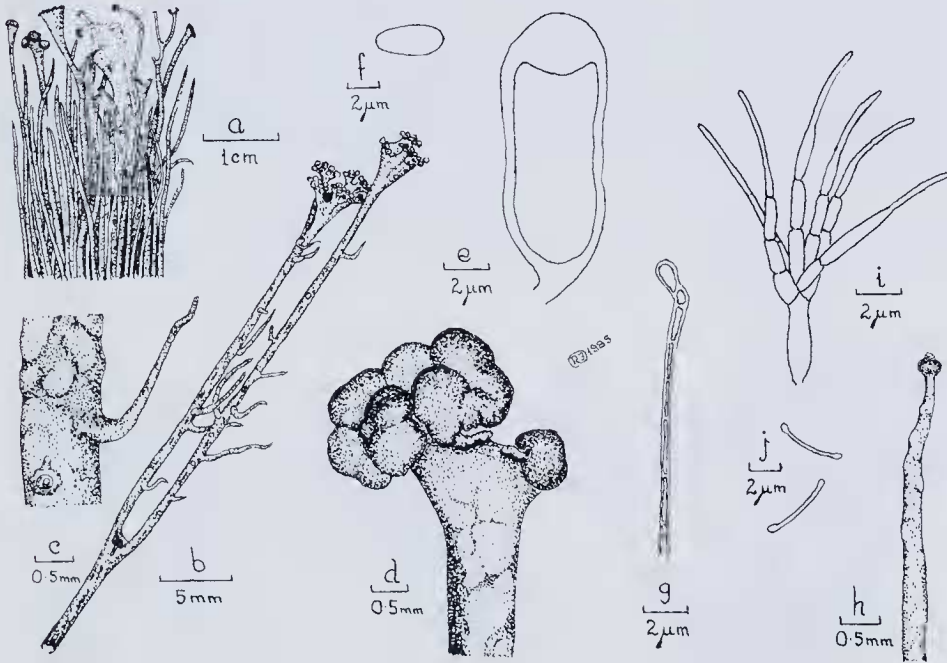


Fig. 9. *Cladonia gracilis* ssp. *tenerrima*. a — habit; b — branched podetium showing subulate side branches and toothed scyphi; c — enlargement of part of podetium; d — apothecia; e — ascus; f — ascospore; g — paraphysis; h — pycnidium at tip of subulate podetium; i — microconidia-bearing hyphae; j — microconidia. a, d-j, from MEL 20262; b-c, from MEL 1047741.

erating from the margins; proliferations bearing apothecia or subulate; cortex smooth to mildly rugulose, continuous, varying in colour from pale greenish-olive to pale cinnamon-brown to dark brown. *Apothecia* on the margins of the cups, irregular when young, almost hemispheric when mature, to 1.5 mm diam., pale brown to dark reddish-brown; margin disappearing; hypothecium hyaline, I+ blue, fading; hymenium up to 30 μm tall including the pale brown epihymenium; paraphyses simple or branched, septate, the apical cell only slightly expanded; asci I+ blue, 17-24 x 7-12 μm ; ascospores simple, ellipsoid, hyaline, 5 x 2 μm . *Pycnidia* on the margins of the cups and terminal on sterile podetia or on short lateral branchlets; microconidia 7-10 x 0.5 μm , curved, slightly thickened at each end.

REACTIONS: K-, C-, KC-, P+ red.

CHEMISTRY: Fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Handspike Point, 17.i.1972, *R. Hnatiuk* (MEL 1033026); one mile N. of Bauer Bay, 28.i.1964, *R. Filson* 5833 (MEL 20262); growing amongst mosses on earth bank along the southern shore of Lake Flynn, 3.iii.1964, *R. Filson* 5899 & *J. Phillips* (MEL 1047741).

DISCUSSION:

This subspecies grows deep in moss cushions, the lower parts of the podetia rotting away, the upper parts slightly protruding above the cushion. Cupless forms may be confused with *C. furcata* as they are very similar in habit; however they can be separated from the latter by the closed axils of the branches.

Cladonia pleurota (Flörke) Schaerer, Enum. Lich. Europ. 186 (1850). — *Capitularia pleurota* Flörke, Ges. Naturf. Freunde Berlin Mag. 2: 218 (1808). — *Cladonia coccifera* var. *pleurota* (Flörke) Schaerer, Lich. helv. spic. 25 (1823). TYPE: "An der Erde, auch wohl auf altem morschen Holze in den Heidegegenden und Waldungen; bey Berlin, bey Jena, im Salzburgerischen, z. B. auf dem Rathhausberge in Gastein, auf der Grasbergalpe im Zillerthale, und wahrscheinlich in allen Gegenden Deutschlands." (n.v.).

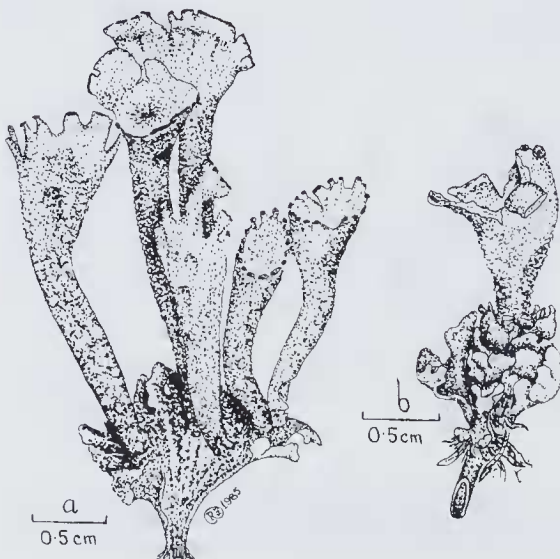


Fig. 10. *Cladonia pleurota*. a — three old and three new podetia arising from a large old primary squamule; b — very old lacerate podetium with numerous persistent primary squamules at the base. All from MEL 20278.

Thallus fruticose, growing amongst mosses, grasses and other lichens; primary squamules persistent or disappearing, irregularly incised; upper side smooth, convex, yellowish-green; lower side white, sometimes with scattered granular soredia. *Podetia* arising from the primary squamules, cup-forming; cups flaring broadly and irregularly, sometimes gradually from the base, sometimes goblet-shaped; margins of the cups regular, entire or incised to deeply lacerate in old specimens; inside of the cups granular-sorediate; base of the podetium corticate, becoming ecorticate and sorediate. *Apothecia* scarlet, on the margins of the cups, uncommon. *Pycnidia* not seen.

REACTIONS: K - , C - , KC + yellow, P - .

CHEMISTRY: Usnic acid, isousnic acid, zeorin.

SPECIMENS EXAMINED:

Handspike Point on rocky outcrop c. halfway between base of point and bottom of escarpment, 11.iii.1964, R. Filson 6322 & P. Atkinson (MEL 20407); c. 1 mile N. of Bauer Bay, 28.i.1964, R. Filson 5812 (MEL 20278).

DISCUSSION:

Cladonia pleurota is the sorediate morph of *C. coccifera* (L.) Willd. Older specimens may be confused with *C. chlorophaea* but *C. pleurota* differs from that species in being more finely sorediate and in containing usnic acid which gives it a more yellowish-green appearance. *C. chlorophaea* also differs in having brown apothecia and pycnidia.

Cladonia pyxidata (L.) Hoffm. Deut. Fl. 2: 121 (1796). — *Lichen pyxidatus* L. Sp. Pl. 2: 1151 (1753). TYPE: "Habitat in Europae sylvis." not known (Ahti 1966: 387).

Thallus fruticose, growing over litter, mosses or earth; primary squamules persistent, to 6 mm long and 4 mm wide, irregularly lobed or crenate; upper side smooth, glaucous-green to olive-green, older specimens becoming brownish-olive; lower side white, esorediate. *Podetia* arising from the primary squamules, to 22 mm tall, cup-forming; cups deep, goblet-shaped, squamulose within; margins of the cups regular, entire, becoming incised to lacerate with age; base of the podetium corticate, sometimes squamulose, the upper parts decorticate, squamulose to granular-sorediate. *Apothecia* dark brown to reddish-brown, sessile on the margins of

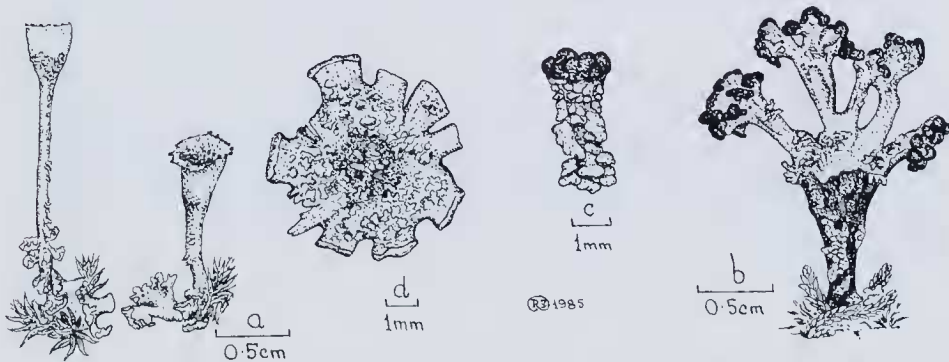


Fig. 11. *Cladonia pyxidata*. a — habit of tall, smooth-cupped podetia; b — an old fertile podetium; c — enlargement of an apothecium on a marginal proliferation; d — looking into a squamulose cup with the marginal apothecia removed. a, from MEL 20282; b-d, from MEL 20408.

the cups, on small proliferations or on secondary cups. *Pycnidia* sessile on the margins of the cups, on the surface of the podetia or on the squamules in the cups.

REACTIONS: K-, C-, KC-, P+ red.

CHEMISTRY: Fumarprotocetraric acid.

SELECTED SPECIMENS EXAMINED:

Gadgets Gully, 18.iii.1964, *R. Filson* & *R. Peterson* (MEL 20408); Nuggets Creek, 20.viii.1948, *N. Laird* (MEL 7717); outcrops in featherbed half mile N. of Aurora Point, 20.ii.1964, *R. Filson* 6195 & *R. Peterson* (MEL 20282); Stoney Creek, 9.i.1972, *R. Hnatiuk* (MEL 1032804); N. Lusitania Bay catchment, 29.xii.1971, *R. Hnatiuk* (MEL 1027245).

DISCUSSION:

C. pyxidata is a cosmopolitan species. It occurs in most Herbfield and Bog alliances on Macquarie Island. It is similar to *C. chlorophaea* from which it can be distinguished by the deeper cups, the larger primary squamules and the squamulose podetia as opposed to sorediate podetia of *C. chlorophaea*.

Cladonia scabriuscula (Delise) Nyl., *C. r.* hebd. Séanc. Acad. Sci., Paris 83: 88 (1876).

This species was represented amongst specimens from Macquarie Island sent to the second author by the Australian National Antarctic Research Expeditions for his determination. These specimens were without precise provenance and have not been available for re-examination for the present study.

Cladonia subantarctica Filson & Archer, sp. nov.

Thallus primarius squamulis evanescentibus. *Podetia* gracilia, usque ad 70 mm elata, simplicia vel ramosa, rami dichotomi vel trichotomi, escyphi, cortice continuo. *Apothecia* ad apices podetiorum. Similis *Cladoniae crispatae* var. *cetrariiiformi* (Delise) Vainio, sed barbatic acidum continens et base podetii moribunda anthracina.

TYPE: Macquarie Island, north east side of Major Lake, 19.ii.1964, *Rex Filson* 6158 & *Roger Peterson* (MEL 20294! HOLOTYPE).

Thallus fruticose, growing in dense clumps amongst grasses; primary squamules disappearing. *Podetia* simple or branched; branching dichotomous or trichotomous, slender, to 70 mm tall and to 1.0 mm diam.; ultimate tips smooth or becoming verrucose and misshapen with increasing exposure; lower parts dying away, the dead basal parts coal-black; podetia cupless, or having narrow cups formed by proliferations around a perforate axil; cortex continuous, smooth, dull to slightly shining, pale brownish-white when sheltered to dark brown when exposed, esorediate, rarely with one or two podetial squamules. *Apothecia* on apical proliferations (mature apothecia not seen). *Pycnidia* common, on apical proliferations or short branches, globose, black, slightly pointed apically; microconidia 6-8 x 1.0 μm , straight or curved.

REACTIONS: K-, C-, KC-, P-.

CHEMISTRY: Barbatic acid.

ADDITIONAL SPECIMENS EXAMINED:

NE. side of Major Lake, *R. Filson* 6151 & *R. Peterson*, 19.ii.1964 (MEL 20261); SE. side of Major Lake, 19.ii.1964, *R. Filson* 6172 & *R. Peterson* (MEL 20267).

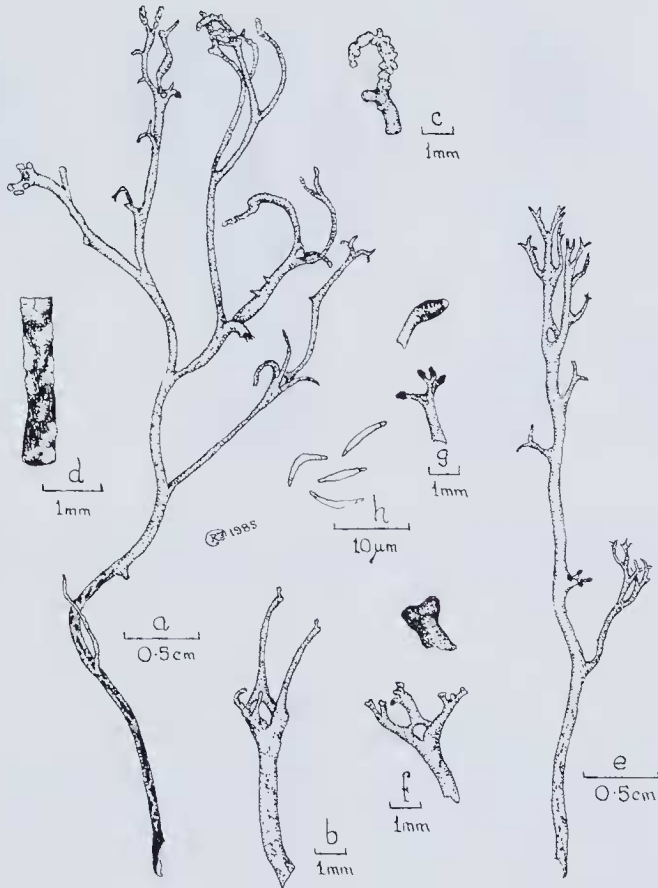


Fig. 12. *Cladonia subantarctica*. a — single podetium separated out from a clump, showing many branches with distorted tips caused by exposure; b — branch tip showing small cup formed by proliferations around an open axil; c — enlargement of rugulose, distorted tip of branch; d — enlargement of blackening lower portion of podetium; e — smooth podetium separated out from a clump from a sheltered habitat; f — ultimate tip showing developing apothecia, with enlargement of developing apothecium; g — ultimate tip showing pycnidia, with enlargement of pycnidium; h — microconidia. a-d, from MEL 20294; e-h, from MEL 20267.

DISCUSSION:

This new species forms part of the 'Cladonia crispata group'. It may be related to *C. crispata* var. *cetrariiformis* (Delise) Vainio, but it differs in the presence of barbatic acid and in the basal parts becoming coal-black when dying away. It is similar to *C. barbatica* Kristinsson (ined) which also contains barbatic acid but in that species the basal parts are yellowish-grey rather than black. Another barbatic acid-containing species, *C. patagonica* Evans, could be confused with *C. subantarctica* but is distinguished by its cup-like scyphi and many podetial squamules. *C. hondoensis* Asahina also contains barbatic acid but is often completely squamulose.

Cladonia subdigitata Nyl., C. r. hebd. Séanc. Acad. Sci., Paris 83: 88 (1876). TYPE: "Expedition astronomique a l'île Campbell 1874, M. Filhol." (H-NYL 37858! LECTOTYPE; MEL 1048659! ISOLECTOTYPE).

Cladonia subdigitata var. *albinea* Dodge, B.A.N.Z. Antarctic Res. Exped.

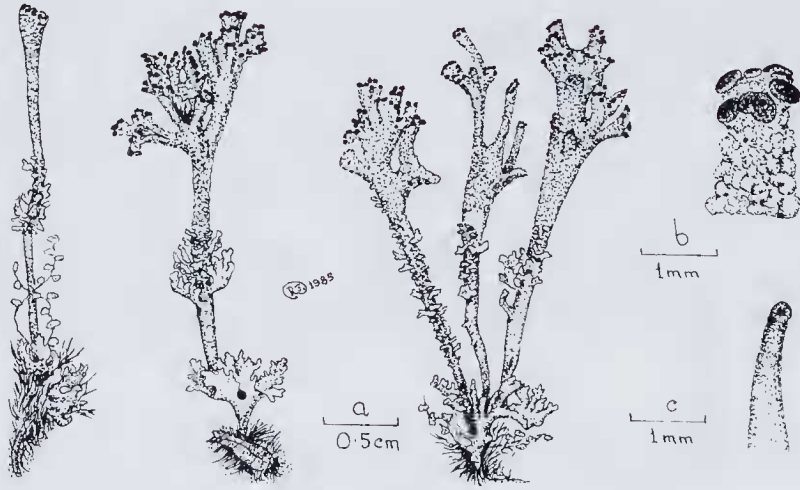


Fig. 13. *Cladonia subdigitata*. a — podetia, separated from a clump in a moss cushion, showing the habit; b — enlargement of the apothecia; c — enlargement of pycnidium on tip of subulate podetium. All from MEL 20277.

1929-31, Rep. Ser., B. Zool.-Bot. 7: 124 (1948). TYPE: "Macquarie Island, north end, Sta. 81, B.A.N.Z.A.R.E. B540-11." (Herb. Dodge, n.v.).

Thallus fruticose, growing thickly in depressions in moss cushions or on earth between the cushions; primary squamules mostly persistent, though sometimes dying away, to 7.0 mm long and 2.5 mm wide, crenate, incised to deeply lacerate and divided; upper side smooth, creamy-brown to creamy-yellow; lower side white, esorediate or slightly granular-soresdiate. *Podetia* arising from the upper surface of the primary squamules, up to 30 mm tall, with cups; cups narrow to broadly flaring, imperforate to perforate, with entire, regular to undulate margins; cups proliferating from the margins, the proliferations simple or scyphous; cortex continuous in the lower parts, grading to verrucose-squamulose and coarsely soresdiate above, yellowish-white in the upper parts, grading to ochre-yellow to brownish-yellow below. *Apothecia* scarlet, around the margins of the cups. *Pycnidia* brown to brownish-red, on the margins of the cups and on the upper parts of the podetia.

REACTIONS: K+ yellow, C-, KC-, P+ yellow.

CHEMISTRY: Usnic and thamnolic acids.

SPECIMEN EXAMINED:

1 mile N. of Bauer Bay, 28.i.1964, R. Filson 5832 (MEL 20277).

DISCUSSION:

Cladonia subdigitata may be confused with *C. pleurota*, the other red-fruiting species of *Cladonia* on Macquarie Island, as both contain usnic acid and are cup-forming. *C. subdigitata* can be distinguished by the cups abruptly flaring towards the top rather than gradually tapering from the bottom, and by the presence of thamnolic acid. The specimens of *C. subdigitata* from Macquarie Island appear inseparable from those collected elsewhere and therefore do not warrant the varietal status given to them by Dodge, loc. cit.

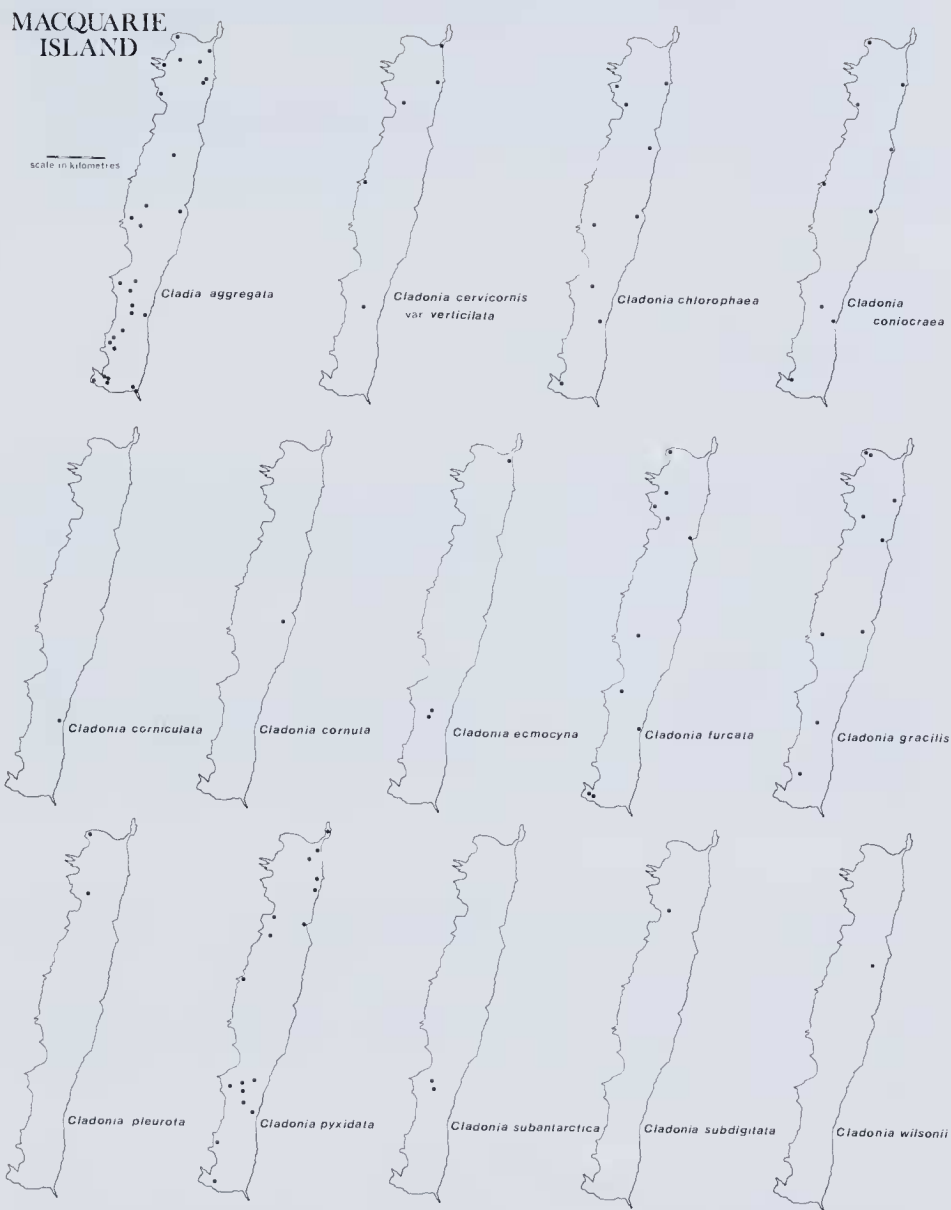


Fig. 14. Known distribution of the species of *Cladia* and *Cladonia* on Macquarie Island.

TENTATIVE DETERMINATION

Cladonia wilsonii A. W. Archer, *Muelleria* 5: 274 (1984). TYPE: Australia, Australian Capital Territory, 35 km SSW. of Canberra, on soil by side of Corin Dam Rd., near Kangaroo Creek, alt. c. 1000 m, 2.v. 1982 *Archer 1315c* (MEL 1036222! HOLOTYPE; H!, NSW! ISOTYPES).

Primary squamules growing amongst mosses and litter, erect, long and narrow, to 7.0 x 0.6 mm, crenulate, lobed, sometimes deeply divided near the tips so as to appear two or three lobed; upper side very pale yellow-green to creamy-brown, smooth to slightly rugulose; lower side white, pale cream, greying towards the base. *Podetia* not seen.

REACTIONS: K+ pale yellow, C-, KC-, P+ yellow.

CHEMISTRY: Atranorin and stictic acid.

SPECIMEN EXAMINED:

E. shore of Lake Prion, 21.ii.1964, *R. Filson 6211* & *R. Peterson* (MEL 20284).

DISCUSSION:

Abundant primary squamules were found in a westerly aspect on the bank just above the shoreline of the lake. In southern Australia these squamules would be referable to *C. wilsonii* because of the chemical constituents; however positive determination is not possible without more material. Similar squamules, lacking podetia, are also found in Tasmania and New Zealand. A description of the podetia from the Australian holotype collection is as follows:

Thallus fruticose, growing amongst mosses and grasses; primary squamules usually persistent, sometimes disappearing, small, 1-2 mm long, 0.5-1.0 mm wide, crenulate to irregularly-lobed; upper side pale green to greyish-green; lower side white. *Podetia* arising from the primary squamules, to 25 mm tall, pale grey to whitish-grey, without cups, branching and splitting longitudinally; cortex continuous, rugulose below, discontinuous and almost areolate above, esorediate. *Apothecia* terminal on branches, single or in clusters.

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